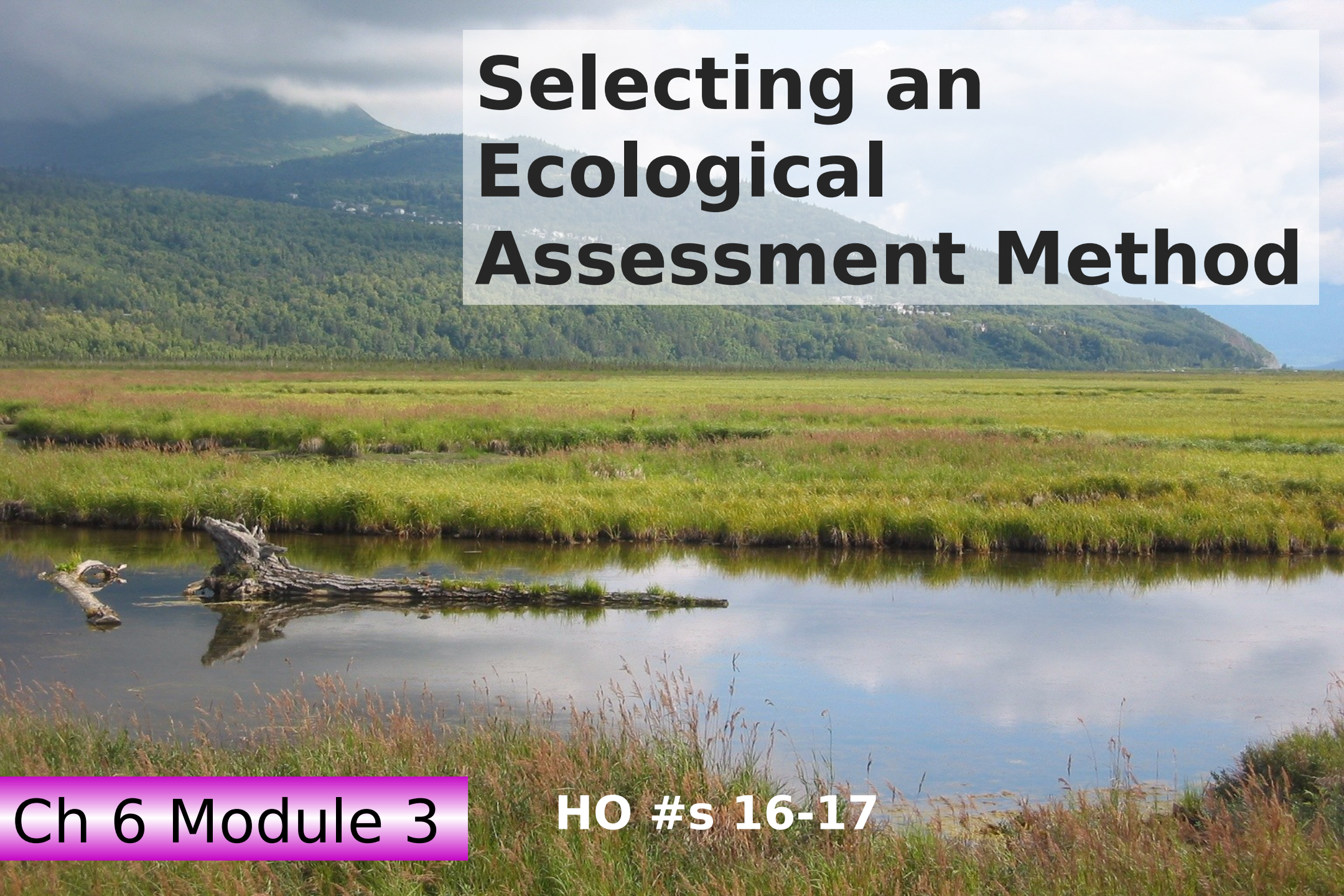


Selecting an Ecological Assessment Method

Ch 6 Module 3

HO #s 16-17

Objectives

- Difference between models and methods
- Basic considerations in method selection
- Array of methods
- Selecting a method
- Overview of commonly used methods
- Model certification requirements

What is a Model?

- An abstraction or simplification of reality
- A set of the most critical components of the modeled system, i.e., a subset
- It is general, precise or realistic, but not all three
- What exactly it is and what it will do is a function of the builder and the data used
- Focus on change

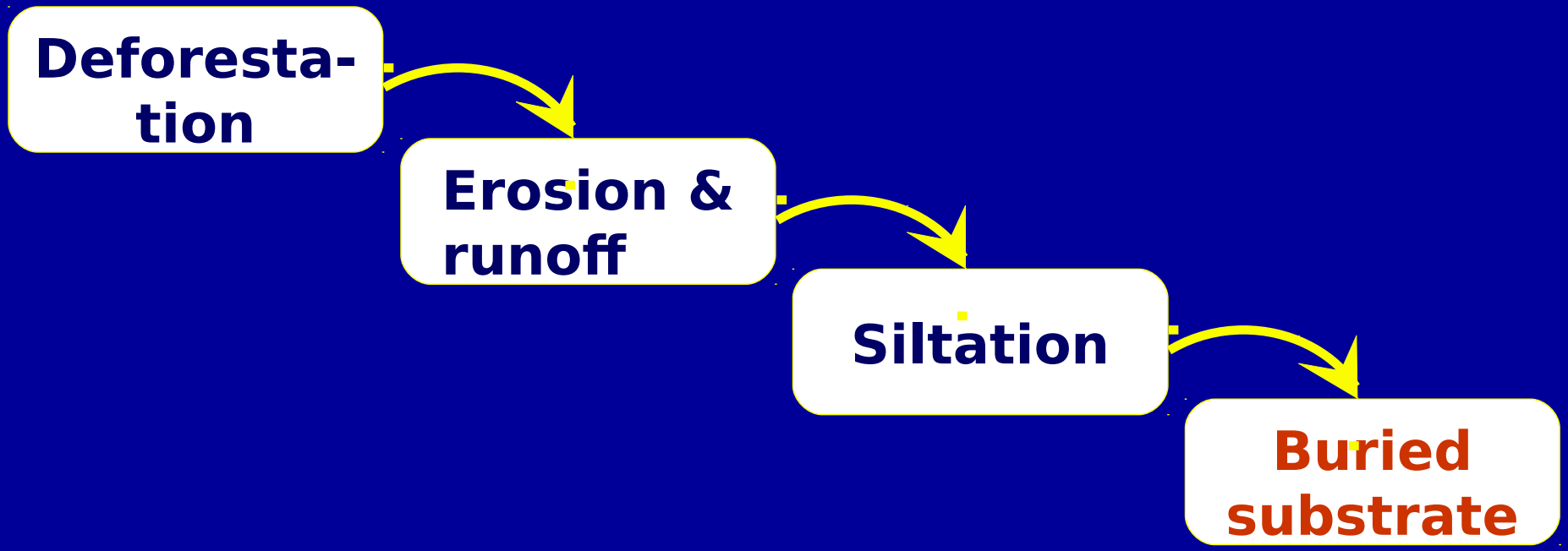
What Kinds of Models Are There?

1. Conceptual and relational
2. Mathematical or relational

Factors used in models:

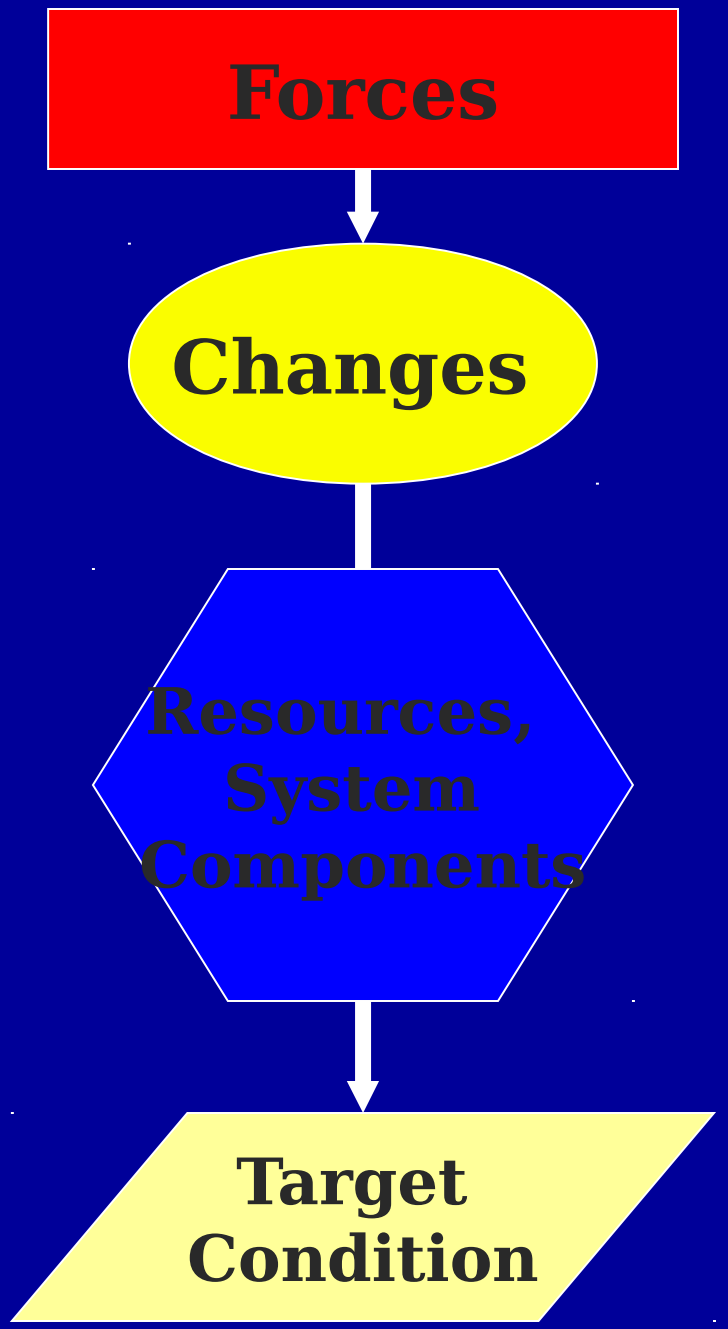
1. Physical
2. Chemical
3. Biological
4. Habitat
5. Spatial

A Simple Thought Model



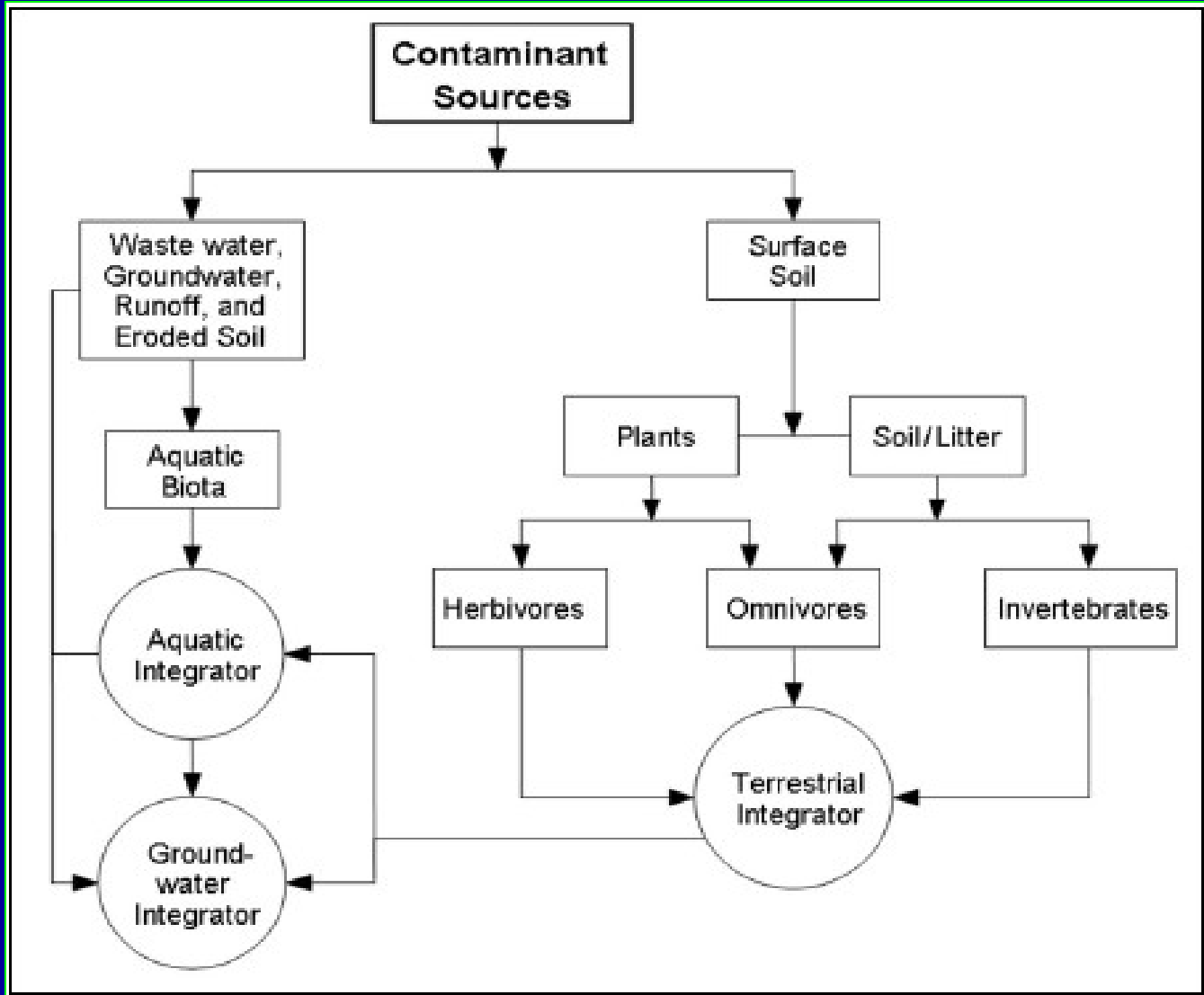
Conceptual Model:

A representation of relationships among natural and human forces and factors, that are believed to change, impact, influence, or lead to an target condition of specified resources.



Conceptual Models

Conceptual models tell the story of "how the system works" and how restoration or other actions alter those processes or attributes of the system.

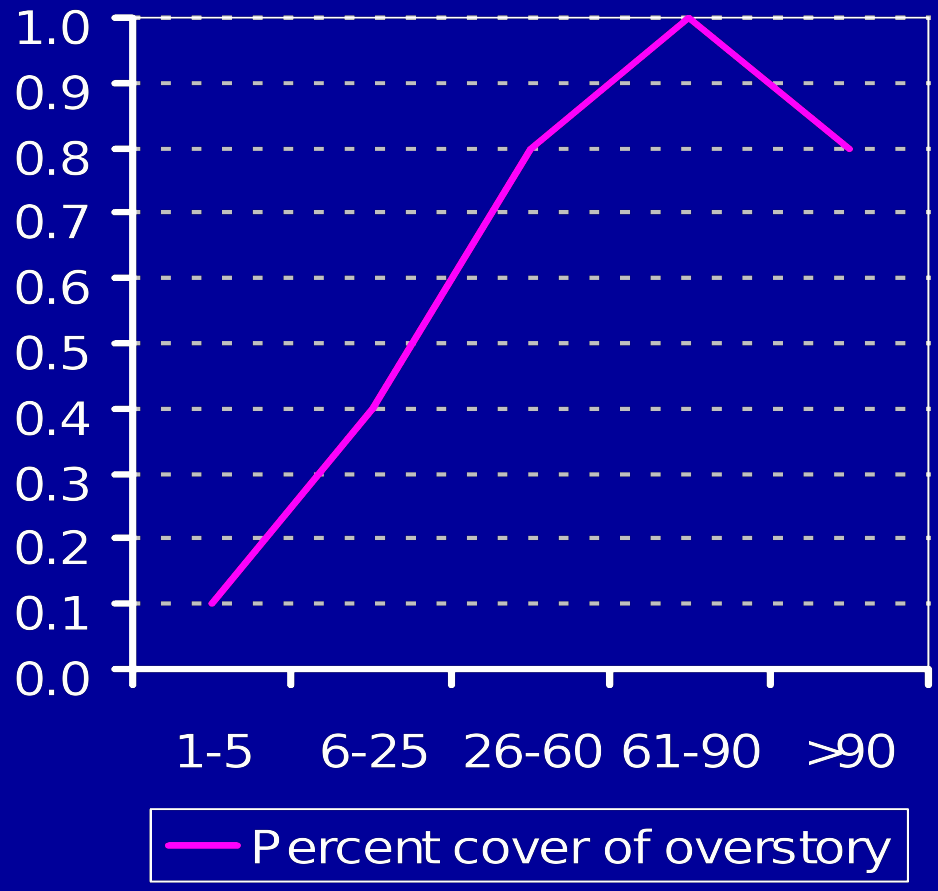


Benefits of Conceptual Models

- Express assumptions and understanding of the entire system
- Organize information concerning the components of the system
- Reduce the complexity of the problem
- Provide basis for communication and consensus building
- Describe links between stressors and affected ecological components

Mathematical Models

- **Identify and measure specific structural or functional criteria**
- **Mathematically expression of the relationship of physical, chemical, and biological factors**



What are basic considerations in selecting a method ?

- Type of available input data
  (e.g., GIS, field work, lab analysis)
- Output – unit of measure
  (e.g., 0-1 scale, # organisms)
- Desired assessment categories.
  (e.g., functions, biological integrity, socioeconomic)
- Habitat type
- Geographic area
- Time constraints (per site)?

Other considerations:

- Assessment objectives (refer method purpose)
- Is method suitable for specific applications?

  (e.g., impact analysis, establish compensation ratios, guide to design, inventory or planning)
- Construct of the method (pj, model based on population data, model based on structure)
- Does the method consider quality and quantity (acreage)
- *Do you need an assessment method NOW?*

Some of the Many Assessment Methods

- AREM
- Coastal Method
- CT Method
- Descriptive App.
- EPW
- FQA
- HAT
- HEP
- HGM Approach
- Hollands-Magee
- IBI
- Interm HGM
- IVA
- Larson Method
- MDE Method
- ME Tidal Method
- MN RAM
- MT Form
- NBM
- NC-CREWS
- NC Guidance
- NEFWIBP
- NH Method
- NJ Watershed Method
- OFWAM
- PAM HEP
- PFC
- Rapid Assess Methodology
- Synoptic Approach
- VIMS Method
- WAFAM
- WCHE
- WET
- WEThings
- WHAMS
- WHAP
- WIRAM

Selecting an ecological assessment method-

where do you look?

Sources for Methods

- USGS databases
- ECO-PCX
- EMRIS (being phased out, but is on the Gateway)
- Universities
- EBM Tools
- other state & federal agencies

Commonly Used Methods

- Professional Judgment
- Habitat Evaluation Procedure (HEP)
- Hydro-geomorphic Approach (HGM)
- Floristic Quality Assessment (FQA)
- Index of Biological Integrity (IBI)

Which can be used as input to Incremental Cost Analyses?

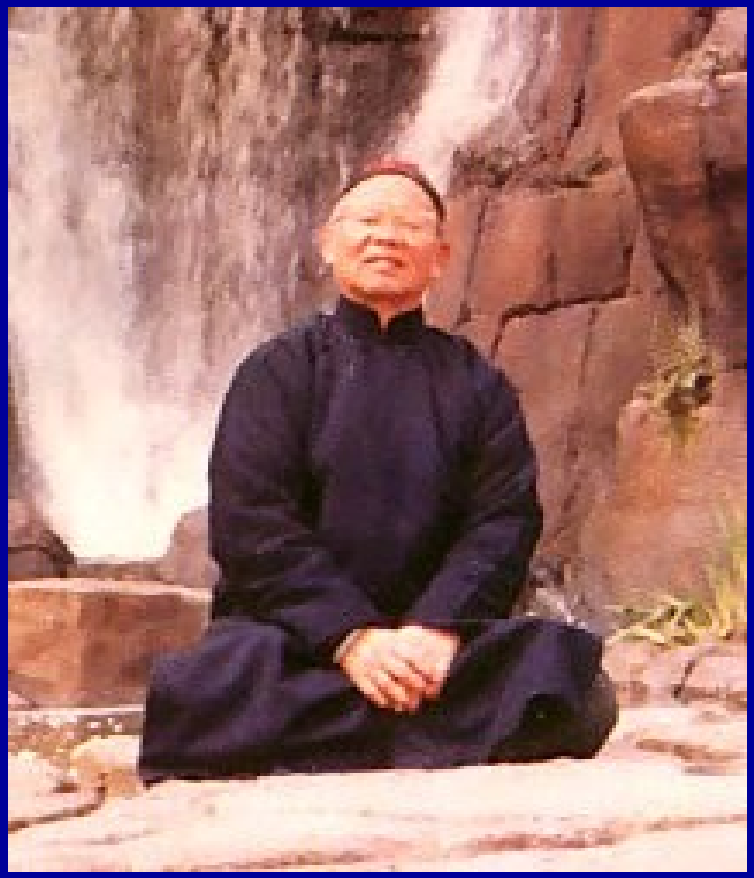
Handout # 17 & 17a

Professional Judgment
(A.K.A. Consult the Guru)

- ***Simple statements***
  - Function present or absent
  - Screening tool
  - Significant value when used by recognized expert

- ***Narrative*** **(usually cite literature or field experiences)**

- ***Rating*** **(e.g., index, score 1-5, low, moderate, high)**



Comments: Professional Judgment

Advantages:

- Usually rapid and cost effective.
- May reveal things overlooked by other approaches.

Disadvantages:

- Generally lacks documentation to support rating.
- Lack of criteria can leads to different scoring by different observers.
- Less defensible.
- Requires field experience to support credentials!
- Observers with an agenda can influence answers!
- Subject to manipulation!
- Difficult to reproduce even if you use same experts!!

Habitat Evaluation Procedures (HEP)

Provides a *numerical* index termed a Habitat Suitability Index or (HSI) incorporating food, water, cover and breeding relationships indicative of real estate's (habitat) ability to support (carrying capacity) a given species or species.

What is HEP?

Biological Accounting System

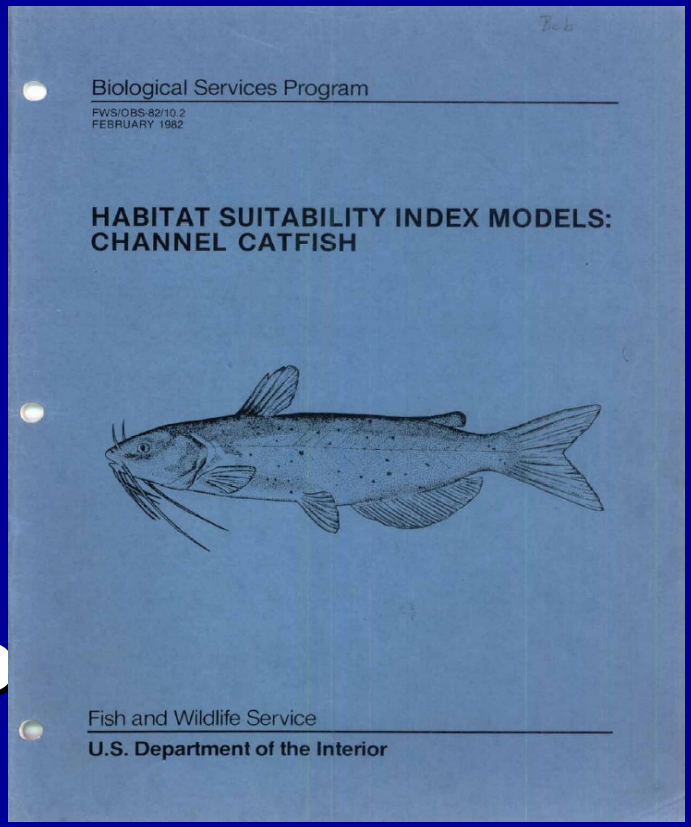
- **Currency = Habitat Units (HU's)**

- **HUs = HSI X Acres**

Method vs. Model

- **Method →**
  USFWS Habitat Evaluation Procedures

- **Model →**
  Habitat Suitability Index fo Channel Catfish



How is Quality Derived?

Quality is measured as a Habitat Suitability Index or HSI which is derived from the measurement of limiting environmental factors called Life Requisites for a species or community.

Inventory and Forecast Conditions

What are Life Requisites?

Life Requisite Components

- Food
- Cover
- Water
- Repro

→ HSI X Area = HU

What is an HSI?

HSI = Habitat Suitability

= Study Area Habitat Conditions

Optimum Habitat Conditions

Score = 0.0 to 1.0

How is Quantity Derived?

Quantity =
the number of **acres** of a cover type.

HUs vs. AAHUs

HUs = gains/losses for a single Target Year

AAHUs = gains/losses averaged over the life of the project

Key HEP Assumptions

- Quantify habitat values.
- Direct relationship between habitat and potential population.
- Relationship expressed as an index.

Key HEP Assumptions

- Habitat suitability is predictable.
- Procedure was not designed to compare across evaluation elements (e.g., species, communities).
- Not designed to compare across evaluation elements or species

HEP Summary

Strengths:

- Objective
- Quantitative
- Standardized nationwide
- Models tested and available
- Can compare different habitats

Limitations:

- Mostly based on habitat variables
- Can manipulate result by changing species
- Time consuming
- Does not address other functions.

HGM
(Hydrogeomorphic Approach)

Purpose: The HGM Approach utilizes reference wetlands as the means for establishing a scale, or index, against which other wetlands of the same type in a particular geographic area (reference domain) can be compared to determine their functional capacity.

HGM
(Hydrogeomorphic Approach)

Habitats: Wetland

Measures: Functional Capacity Units

Units: FCI and FCU

1 FCI x 1 acre = 1 FCU

Functional Capacity Index: An measure of how well study site functions compare to functions in reference wetlands of the region.

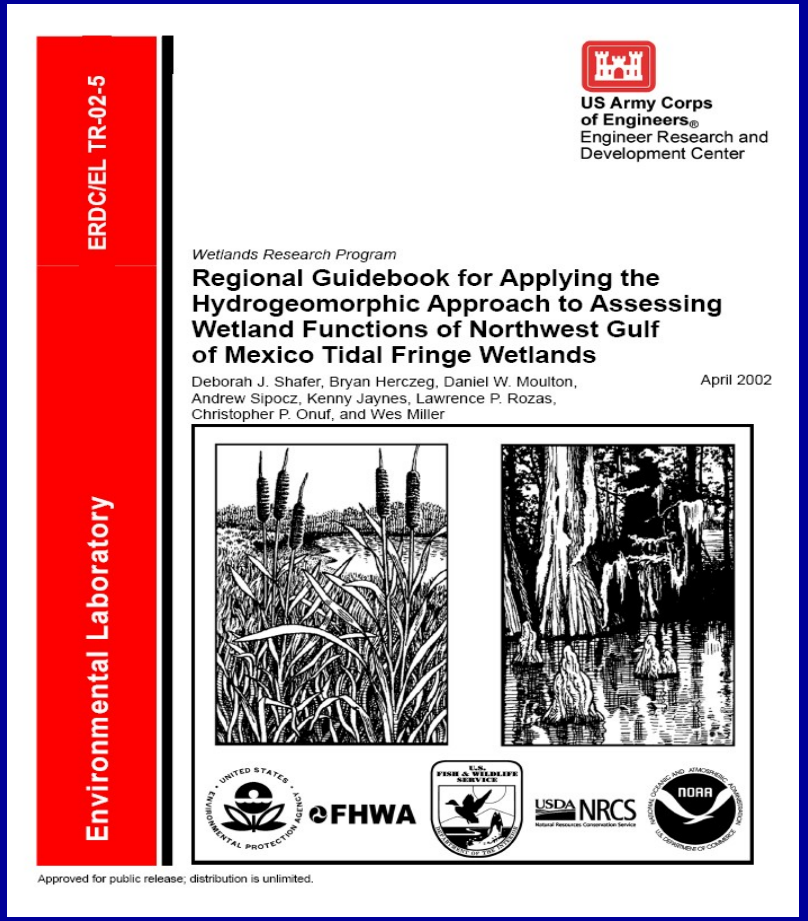
Method vs. Model

- **Method →**

  Hydrogeomprphic (HGM) Approach to Assessing Wetland Functions

- **Model →**

  Regional Guidebook for NW Gulf of Mexico Tidal Fringe Wetlands


ERDC/EL TR-02-5
Environmental Laboratory
US Army Corps of Engineers®
Engineer Research and Development Center
Wetlands Research Program
Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Northwest Gulf of Mexico Tidal Fringe Wetlands
Deborah J. Shafer, Bryan Herczeg, Daniel W. Moulton, Andrew Sipocz, Kenny Jaynes, Lawrence P. Rozas, Christopher P. Onuf, and Wes Miller
April 2002
FHWA
USDA NRCS
NOAA
Approved for public release; distribution is unlimited.

Hydrogeomorphic Approach Overview

- Developed to assess wetland functions in the 404 Regulatory Program
- Focuses on regional wetland subclasses
- This classification reduced variability and increased sensitivity.
- Concept and construct is similar to HEP, but addresses several functions rather than life requisites.
- Developed by the Corps of Engineers

HGM Summary

Strengths:

- Objective
- Quantitative
- Several functions*
- Standardized nationwide
- Rapid once models ready

Limitations:

- Model development time consuming
- Cannot compare different wetland classes
- Need to develop most models

*The class exercise module focuses on nutrient

FQA - Floristic Quality Assessment

- Standardized tool used for site assessment of wetland floristic quality
- Developed by Swink and Wilhelm for Chicago area*
- Assesses the "conservatism" of plant species
- Quality of area is reflected by richness in conservative

Plants of the Chicago Region, by Floyd Swink and Gerould Wilhelm, Indiana Academy of Science, 1994

FQA-Floristic Quality Assessment

- Uses Coefficients of Conservatism
  - 9-10 Native, high fidelity, threatened
  - 7-8 Native, stable climax
  - 4-6 Native, early successional
  - 1-3 Native, widespread
  - 0 Native, opportunistic inv
  - 0 Alien, noxious invader
- and number of species to determine the Floristic Quality Index (FQI)

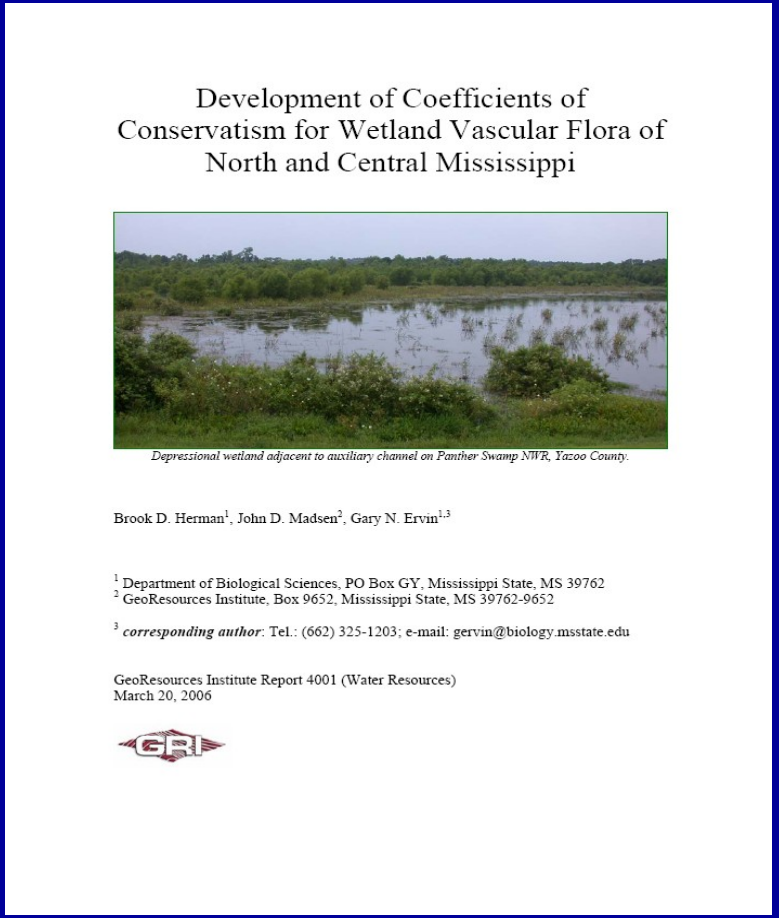
Determining the Floristic Quality Index (FQI)

- Compile a list of plants in the area
- Assign coefficients of conservation to each
- Determine the mean coefficient value of the area
- Multiply the mean coefficient by the square root of the total number of native species
- The product is the Floristic Quality Assessment Index or FQI
- $FQI = R \sqrt{N}$
  - *R= sum of Conservation Coefficients*
  - *N= number of native plants recorded*

Method vs. Model

- **Method → Floristic Quality Assessment**

- **Model → Coefficients of Conservatism for Vascular Plants of North and Central Mississippi**



Development of Coefficients of Conservatism for Wetland Vascular Flora of North and Central Mississippi

Depressional wetland adjacent to auxiliary channel on Panther Swamp NWR, Yazoo County.

Brook D. Herman[1], John D. Madsen[2], Gary N. Ervin[1,3]

[1] Department of Biological Sciences, PO Box GY, Mississippi State, MS 39762
[2] GeoResources Institute, Box 9652, Mississippi State, MS 39762-9652

[3] ***corresponding author***: Tel.: (662) 325-1203; e-mail: gervin@biology.msstate.edu

GeoResources Institute Report 4001 (Water Resources)
March 20, 2006

States with Coefficients of Conservation Lists

- Illinois
- Wisconsin
- Michigan
- Missouri
- Indiana
- Kentucky
- Mississippi
- Northern Ohio
- Iowa
- North Dakota
- South Dakota
- West Virginia

FQA Process

- **Convert FQI to a 0-1 scale and multiple by acres**

- **Some say FQA incorporates size because plants with high conservatism coefficient will only be found in larger sites. (not always true)**

- **Software available from Conservation Design Forum***

*www.cdfinc.com

FQA Summary

Strengths:

- Provides quantitative and uniform set of measurements
- Allows for comparison of quality among many sites and for tracking changes over time
- Availability of data

Limitations:

- Assignment of Coefficients is subjective
- Coefficients can be reg

IBI –Index of Biotic Integrity

- Multi-metric index for designed to measure the aquatic vertebrate community and surrounding conditions using aquatic species as indicators
- Popular biological indicator of watershed health
- Original index developed for Central IN and IL (Karr 1981)
- Different versions were developed for different regions and ecosystems

IBI
(Index of Biotic Integrity)

Habitats: streams, mud flats, wetlands, and deepwater habitats

Measures: biological integrity

Units: IBI

IBI = sum of metric* scores

* A parameter with predictable and empirical patterns when plotted against a gradient disturbance.

IBI –Index of Biotic Integrity

- Original Index included 12 Metrics in 5 Categories
  - Species Richness
  - Indicator Species
  - Trophic Function
  - Reproduction Function
- Each metric is scored based on comparison of sampled site with reference site
- Maximum score of 5 for each metric and scores are totals

Method vs. Model

- **Method →**
  Index of Biotic Integrity

- **Model →**
  An Estuarine Benthic Index of Biotic Integrity for the Mid-Atlantic Region

Estuaries Vol. 25, No. 6A, p. 1219–1230 December 2002

An Estuarine Benthic Index of Biotic Integrity for the Mid-Atlantic Region of the United States. I. Classification of Assemblages and Habitat Definition

ROBERTO J. LLANSÓ[1,*], LISA C. SCOTT[1], DANIEL M. DAUER[2], JEFFREY L. HYLAND[3], and DAVID E. RUSSELL[4]

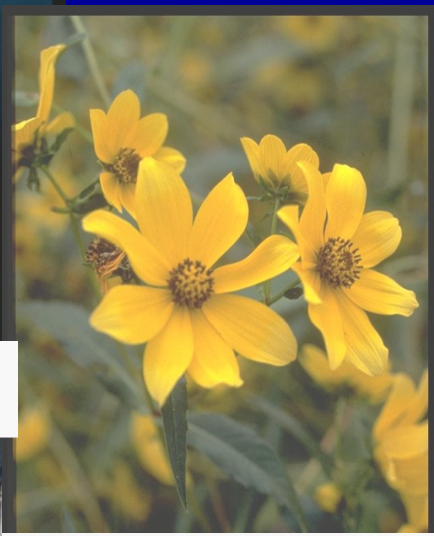
[1] *Versar, Inc., 9200 Rumsey Road, Columbia, Maryland 21045-1934*
[2] *Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529*
[3] *National Oceanic and Atmospheric Administration, National Ocean Service, 219 Fort Johnson Road, Charleston, South Carolina 29412-9110*
[4] *U.S. Environmental Protection Agency, Region III, Environmental Science Center, 701 Mapes*

Different Assemblages

Birds

Amphibians

Fish

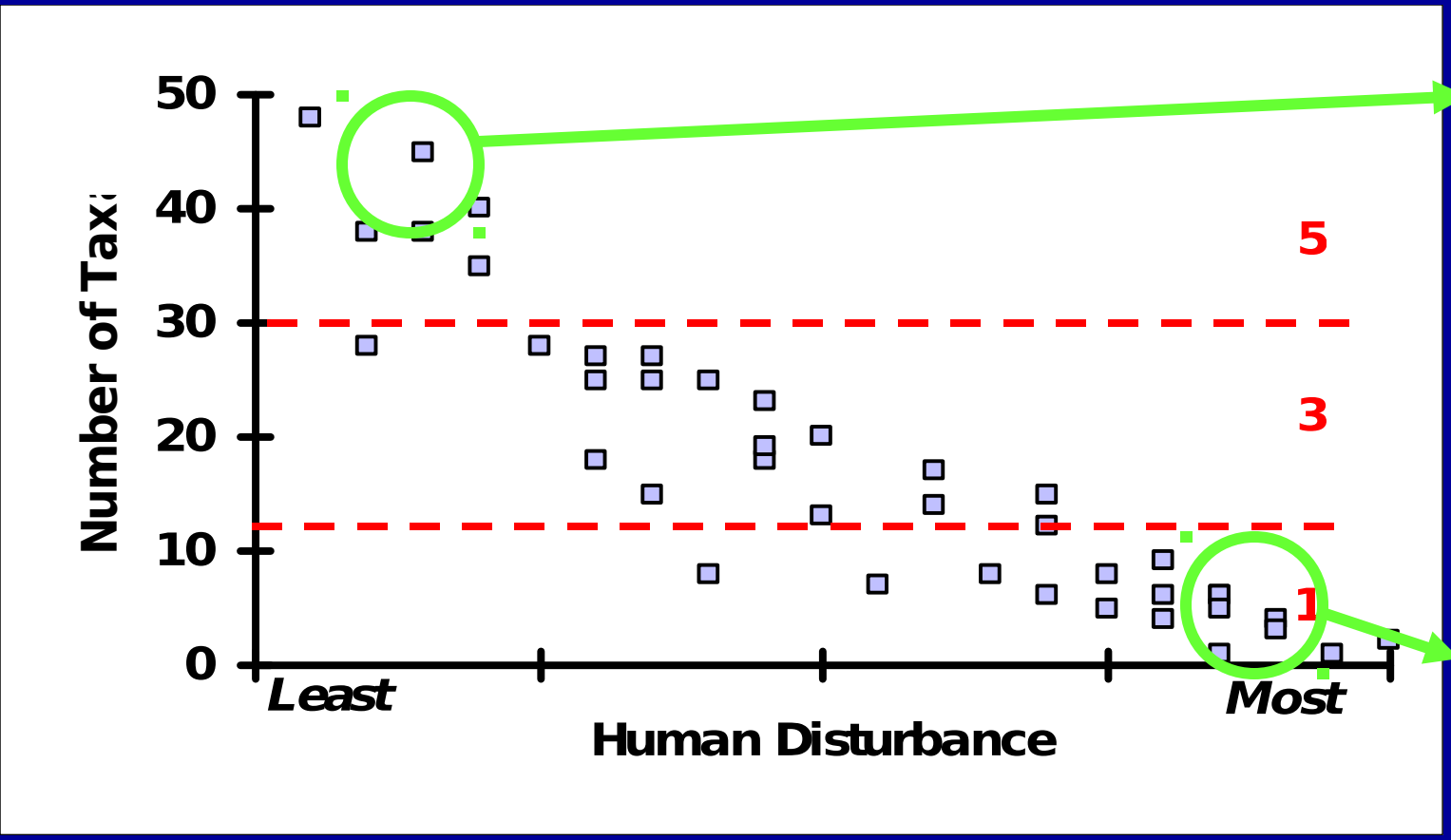


Vascular Plants

Macroinvertebrates

Algae

Scoring a Metric



Example of Multiple Metrics

	Value	Score	Value	Score
Number of Taxa	27	5	12	1
% Water Boatmen	15%	5	60%	3
% Erpodella	5%	5	40%	1
% 3 Dominants	40%	5	70%	3
# Midge Taxa	12	3	4	1
# ETSD	6	5	1	1
# Intolerant Taxa	4	3	0	1
# Leech Taxa	4	5	1	1
# Odonata Taxa	5	5	2	1
# Snail Taxa	6	5	3	3
WIBI		46		16

Wisconsin IBI

A

B

IBI

Strengths:

- Direct measurement of biological integrity.
- Accounts for multiple stressors.
- Helps to diagnose stressor(s) impacting biota.
- Accounts for multiple measures of community attributes.
- Good existing condition information.

Limitations:

- Not good at future predictions
- Not directly correlated to habitat variables or physical conditions.
- Non-biological functions not assessed (e.g. flood storage).
- Time consuming.
- Cannot compare different habitat types.
- Scores are geographically specific

Model Certification

- Mandatory for any model or analytic tool used in the planning process.

- Information Quality Act (PL106-544) 2001
  - Implemented by EC 1105-2-412 Jan 09
  - Policy Guidance CECW-CP letter of 13 Aug 2008
  - Policy Guidance Memo on Certification of Ecosystem Output Models, Aug 08

  - EXEMPT: CAP* projects

*CECW-P 19 Jan 2011 CAP Process Improvements

Model Certification Criteria

Models should:

- **Be technically sound and computationally correct.**
- **Be based on validated (verified) and accepted "state of the art" theory**
- **Incorporate Corps' policies and requirements**
- **Properly incorporate conceptual theory into computer code**
- **Define assumptions inherent in model**

Certification Process (CP)

- CONTACT Eco-PCX – POC: Jodi Staebell (MVD)
- Process found on the ER Gateway:

  http://cw-environment.usace.army.mil/

Model Documentation

- Documentation includes
  - Background
  - Theory, assumptions, analytical requirements, formulas
  - Software/hardware, testing/validation process,
  - Availability of input data, usefulness to support project analysis, tech support, training
- Software/spreadsheets also provided

How can the model proponent help?

- Identify models early
- Prepare model documentation
- Test/validate model
- Check software
- Identify expertise needed
- Be open to process
- Pool funds for multiple-use models

Recommendations

- **Identify when there is a need to assess.** Realize may need for 1 or more approaches (e.g., assessment procedure, bpj, sample biota,)
- **Take the time to carefully *define* the assessment *objectives*, then *select* an *approach***
- **Look beyond your District to learn of new methods (e.g. web sites, the MVDPCX and other resources).**
- **Know what the method does.**

  Don't blindly adopt and use. Know it's limitations.
- **Consider modifying an existing method or model.**

  Note that modification can require recertification

Sage Advice

- Many ways to assess (BPJ and beyond…).
- Carefully define your objectives.
- See what is used in your division.
- Always explore other possibilities
- Manipulation is possible! Be aware of what worked in the past!

Final notes (Take away Points)

- **Methods differ and new ones come on line constantly**
- **Discuss the method selected with other members of the team before any final decisions.**
- **Finally, remember EC 1105-2-412 Jan 09 requires certification of any selected method.**